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ACQUISITION OF AN ALL-SOLID STATE FEMTOSECOND LASER SYSTEM

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13. ABSTRACT (Maximum 200 words)

We have successfully constructed a rather unique femtosecond laser system, which has already been quite productive. The system was designed around a commercial pump source, the Clark MXR-2001 system, which is a diode-pumped, additive chirp mode locked fiber laser, regeneratively amplified to produce 775 nm pulses of ~160 fs, 800 mW, at 1KHz. The output of the pump laser is split successively with 50% beam splitters, to use ~200 mW beams to pump two home-built Non-collinear Optical Parametric Amplifiers (NOPA). The latter have innovative details, to generate final outputs of 10 uJ/pulse, at 1 KHz, with pulsedwidths of 10-30 fs, in the entire visible spectrum. The system enables nonlinear multicolor, multi-beam measurements, of quantum coherences, with experimental time resolution of 14 fs, in notoriously difficult measurements of 4-wave and 6-wave mixing in condensed media. The design of the NOPA is illustrated in Fig.1. The pump entering the NOPA is split between two arms, 4% is used to generate white light in a 200um sapphire disk, while the rest is used to double in a BBO x-tal, then to pump the NOPA x-tal to generate super radiance. The white light is volume matched with the superradiance on a 14° incline, and the time-spectral overlap of the chirped white light is amplified. The single delay line of TSI in the figure is sufficient to tune the color of the output. The bandwidth of the output is controlled by the chirp in the white light. Typically, bandwidths that can sustain 10 fs operation can be obtained by adjusting the white light optics. While ultrashort pulses are the aim of our setup, in many measurements longer pulses are desired. This can be managed by inserting a dispersion element in the white light arm, a water cell or an SF10 blank of variable length is used to this end.

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FINAL REPORT
AFOSR (F49620-01-1-0319)
ACQUISITION OF AN ALL-SOLID STATE FEMTOSECOND
LASER SYSTEM

We have successfully constructed a rather unique femtosecond laser system, which has already been quite productive.^{1,2} The system was designed around a commercial pump source, the Clark MXR-2001 system, which is a diode-pumped, additive chirp mode locked fiber laser, regeneratively amplified to produce 775 nm pulses of ~160 fs, 800 mW, at 1KHz. The output of the pump laser is split successively with 50% beam splitters, to use ~200 mW beams to pump two home-built Non-collinear Optical Parametric Amplifiers (NOPA). The latter have innovative details, to generate final outputs of 10 μ J/pulse, at 1 KHz, with pulsewidths of 10-30 fs, in the entire visible spectrum. The system enables nonlinear multicolor, multi-beam measurements, of quantum coherences, with experimental time resolution of 14 fs, in notoriously difficult measurements of 4-wave and 6-wave mixing in condensed media.

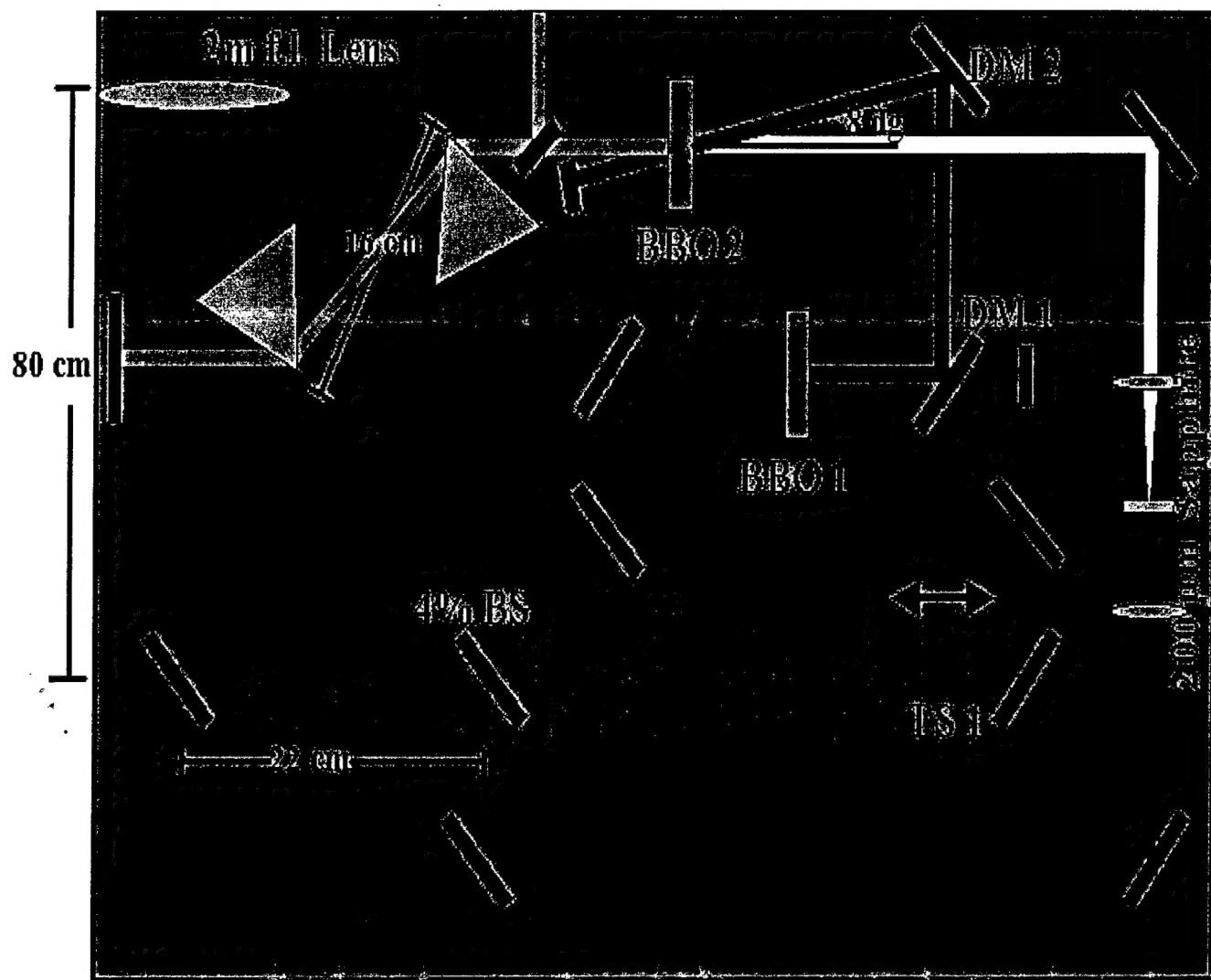
The design of the NOPA is illustrated in Fig. 1. The pump entering the NOPA is split between two arms, 4% is used to generate white light in a 200 μ m sapphire disk, while the rest is used to double in a BBO x-tal, then to pump the NOPA x-tal to generate super radiance. The white light is volume matched with the superradiance on a 14° incline, and the time-spectral overlap of the chirped white light is amplified. The single delay line of TS1 in the figure is sufficient to tune the color of the output. The bandwidth of the output is controlled by the chirp in the white light. Typically, bandwidths that can sustain 10 fs operation can be obtained by adjusting the white light optics. While ultrashort pulses are the aim of our setup, in many measurements longer pulses are desired. This can be managed by inserting a dispersion element in the white light arm, a water cell or an SF10 blank of variable length is used to this end (not shown in the figure).

We are quite proud of the system, which was built entirely by graduate students in record time, and which has already produced impressive data. As such, details of the design and performance will be published in a manuscript that is nearly complete.³

¹ M. Karavitis, D. Segale, Z. Bihary, M. Pettersson, and V. A. Apkarian, Low Temp. Physics (in press) "Time resolved CARS measurements of vibrational decoherence"

² Z. Bihary, M. Karavitis and V. A. Apkarian, J. Phys. Chem. (submitted, 2002) "Onset of decoherence: Six-wave mixing measurements of vibrational decoherence on the excited electronic state"

³ M. Karavitis and V. A. Apkarian (in prep), "Long-lived, coupled impurity-cage vibrational coherences"



Distance from 4% BS to BBO2: 93cm

BBO1: 5 x 5 x 1 mm, p-Coated, 30 degree cut

BBO2: 5 x 5 x 2 mm, uncoated, 28 degree cut

DM1 = DM2: Dichroic Mirror (HR 400, HT 800)